Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2016; 4(4): 1153-1155
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Received: 29-05-2016
Accepted: 30-06-2016

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The proximate compositions, carbohydrate contents and energy values of three freshwater fish from Seyhan River in Adana/Turkey

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Abstract
The objective of this current study is to investigate the proximate composition (protein, lipid, moisture, and ash) of tench (*Tinca tinca*, Linnaeus, 1758), Prussian carp (*Carassius gibelio* Bloch, 1783), and king nase fish (*Chondrostroma regium* Heckel, 1843) which are considered economically important fish species in the region at the time when this study was carried out. Tench was extinct short after this current study was done.

Keywords: Proximate composition, *Tinca tinca*, *Carassius gibelio*, *Chondrostoma regium*

1. Introduction
Tench, is one of the cyprinid species widely distributed in Europe and Asia [1] and live in eutrophic lakes. However a number of authors reported that this fish species feed on zooplankton and adult insect [2, 3], it is thought that its primary diet was aquatic plants and benthic macro invertebrates. Tench was one of the important common fish species in this study was carried out and was extinct short after this study was done. According to both fisherman and scholars in the region, that could be either overfishing to catch zander or one possible negative effect of the invasion of Prussian carp. It is also possible to have two reasons which were given above. This is not an issue to investigate for this study, but give some important knowledge about why further investigations did not carried out for this fish in the this region.
Prussian carp was reported for the first time in 1986 in Gala Lake in the Thrace Region [4, 5] and is known as an invasive species seen in inland waters of Turkey. The fish's reproductive properties and other characteristic advantages made the fish increase rapidly [6-10] especially, in artificial water bodies to support commercial or recreational [11].
Kingnase fish is also another economically important fish species in the region and it is called "hamur" by the people around the region in Seyhan Dam Lake (Adana/Turkey) [12]. Kingnase fish is a native species to Iran, Syria and Turkey and its distribution is in Asia [13].
Fish is one of the important diet not only for human, but also for animals. Proximate composition (protein, lipid, moisture, and ash) of fish is considered an important issue to consumers, scholars, and processers for many different reasons. The major compositions of fish are generally 16-21% protein, 0.2-25% fat, 1.2-1.5% ash, 0-0.5% carbohydrate, and 66-81% moisture [14]. The composition of the fish may differ from species to species. The aim of this current study is to investigate proximate, carbohydrate and energy composition a fish in order to determine the differences.

2. Material and Methods
2.1. Materials
Tench (*Tinca tinca*, Linnaeus, 1758), Prussian carp (*Carassius gibelio* Bloch, 1783), and king nase fish (*Chondrostroma regium*, Heckel 1843) were caught by gill net in November 2010 in Seyhan River (Adana/Turkey).

2.2. Methods
Proximate composition analyses were carried out according to AOCS (Anonymous, 1992) procedures right after the body measurements. Fish lengths were measured with a ruler.

Each fish specimens were weighted with the precisions close to 0.01.

The moisture content was determined by drying samples at 105±2 °C until a constant weight was obtained. Determination of crude lipid was performed by using a modified Bligh and Dyer method [15]. For each fish species 10 g of fish muscle was weighed and placed into a homogenisation flask. Pure water (8 ml) was then added. After the addition of 20 ml of chloroform and 40 ml of methanol, the mixture was homogenised for 60 seconds. An additional 20 ml of chloroform was added, and the mixture was homogenised for 30 seconds. Finally, 20 ml of water was added, and the mixture was homogenised for a further 30 seconds. The homogenate was centrifuged for 15 minutes at 2000 rpm. After centrifugation, the aqueous layer was removed by aspiration. A total of 20 ml of the chloroform layer was transferred into a dry pre-weighed round-bottom flask. The chloroform was evaporated by using a rotary vacuum evaporator at 45 °C. Final drying was performed in an oven at 105 °C for 30 minutes. The flask was allowed to cool to room temperature in desiccators for approximately 20 minutes and weighed. The following equation was used to calculate the lipid content in the sample.

Equation: Percentage of lipid in the fish

$$\% \text{ Lipid (B \& D)} = \frac{W_L}{W_S} \times \frac{V_1}{V_2} \times 100$$

Where:

W_L= Weight of the lipid extracted (g)

W_S= Weight of the sample (g)

V_1 = Total volume of chloroform that used for lipid extraction (mL)

V_2= Volume of chloroform used for evaporation (mL)

Crude protein content was calculated by using nitrogen content obtained by the Kjeldahl method. A conversion factor of 6.25 was used for calculation of protein content (Anonymous, 1992). Total ash content was determined by samples at 550±10 °C for 6 hours. Carbohydrate content and energy value were calculated by described [16]. All chemicals used were in analytical grade and obtained from Merck (Darmstadt, Germany) and Sigma Aldrich (St. Louis, MO, USA).

Data were subjected to analysis of variance (ANOVA) and mean comparison was carried out using Duncan's test. Significance was established at $P<0.05$.

3. Results and Discussion

The proximate composition of fish generally varies depending upon season, age, maturity, sex, and availability of food. During long starvation periods, fish may utilize the protein in its body to survive. However, the main changes in the body composition occur in moisture and lipid content. The lipid contents of the fish in this current study differed from each other and these differences were found to be statistically significant ($P<0.05$). Additionally, the moisture and lipid contents of the fish had an inverse correlation in this study.

Proximate compositions of the tench, king nase fish, and Prussian carp are given in Table 1. The total length ranged from 21-31 cm for tench, 18-23 cm for king nase fish, and 19.5-21cm for19-23 for Prussian carp. In addition, total weight of the fish ranged from 150.78-482.28 g for tench, 101-167.67 g for king nase fish, and 143-179 g for Prussian carp.

The levels of protein were calculated to be 15.96%, 18.48%, and 19.43% for tench, king nase fish, and Prussian carp, respectively. The protein levels of Prussian carp in this study were found to be higher than that of Prussian carp in Cildir Lake [17] and in E gridir Lake [18]

Table 1: Proximate compositions of the tench, king nase fish, and Prussian carp

	Tinca tinca	***Chondrostroma regium***	***Carassius gibelio***
	Tench	King nase fish	Prussian carp
Total length (cm)	26.00±5.00	21.50±2.18	20.40±0.79
Total weight (g)	312.11±166.22	143.05±37.00	158.17±18.66
Protein (%)	15.96±0.17[a]	18.48±0.38[b]	19.43±0.21[c]
Lipid (%)	1.04±0.03[a]	2.76±0.13[b]	3.43±0.17[c]
Moisture (%)	81.88±0.37[a]	77.73±0.91[b]	76.24±0.31[c]
Ash (%)	0.91±0.04[a]	0.77±0.04[b]	0.81±0.04[b]
Carbohydrate content (%)	0.45±0.30 [a]	0.55±0.03 [a]	0.15±0.07 [a]
Energy value	314.65±3.84 [a]	422.33±13.06 [a]	458.77±7.68 [a]

The data represent means± standard deviation (n=3) [except Carbohydrate content and energy value (n=2)] Mean± standard deviation followed by the different letters within a row is significantly different ($P<0.05$).

The proximate composition of fish varies depending upon season, age, maturity, sex, and availability of food in the environment [19]. Fish may utilize the protein in its body to survive during long starvation periods. However, the main changes in the body composition occur in moisture and lipid content. The lipid contents of the fish in this current study differed from each other and these differences were found to be statistically significant ($P<0.05$). Additionally, the moisture and lipid contents of the fish had an inverse correlation in this study.

The average levels of moisture in trench, king nase fish, and Prussian carp were found to be 81.88, 77.73, and 76.24, respectively. Compared with the previous studies which were reported by Dagtekin and Başturk (2014) [17] in Cildir Lake and Sule (2011) [20] in Egridir Lake and Izci (2010) [18] in Egridir Lake, on Prussian carp, Moisture content of the Prussian carp in this study was almost the same as that of the these earlier studies.

Ozyilmaz and Palali, (2014) [21] in Ataturk Dam Lake, Dagtekin ve Başturk (2014) [17] in Cildir Lake and Sule (2011) [20] in Egridir Lake and Izci (2010) [18] in Egridir Lake were studied the lipid levels of the Prussian carp and found to be 1.61%, 1.59%, 3.78, and 4.62%. The average lipid levels of the Prussian carp in Seyhan River in this study were 3.43%, which is close to the study of Sule (2011) [20] in Egridir Lake and higher than Ozyilmaz and Palali, (2015) [21] in Ataturk Dam Lake, Dagtekin ve Başturk (2014) [17] in Cildir Lake and also lower than that of Izci (2010) [18] in Egridir Lake.

The highest ash content was found to be in tench. The ash content shows the richness of the fish. In this case, the element content of the tench is supposed to be higher than that of Prussian carp and king nase fish. The average ash of the Prussian carp in Seyhan River in this study was found to be lower those of Dagtekin ve Başturk (2014) [17] in Cildir Lake and also lower than that of Izci (2010) [18] in Egridir Lake.

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